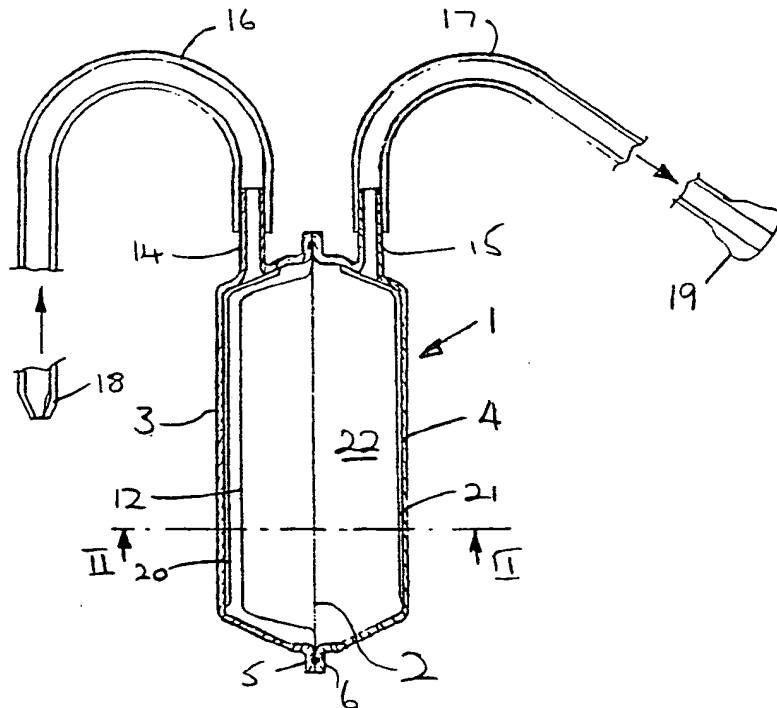


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>4</sup> :  A61M 1/00	A2	(11) International Publication Number: WO 89/ 05665 (43) International Publication Date: 29 June 1989 (29.06.89)
<p>(21) International Application Number: PCT/GB88/01122</p> <p>(22) International Filing Date: 23 December 1988 (23.12.88)</p> <p>(31) Priority Application Number: 8730064</p> <p>(32) Priority Date: 23 December 1987 (23.12.87)</p> <p>(33) Priority Country: GB</p> <p>(71)(72) Applicants and Inventors: VEALE, Francis, Clement [GB/GB]; VEALE, Moray, Sian [GB/GB]; 11 Victory Avenue, Horndean, Hampshire PO8 9PH (GB).</p> <p>(74) Agent: BROOKS, Nigel; Hill Hampton, East Meon, Petersfield, Hampshire GU32 1QN (GB).</p>		<p>(81) Designated States: AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB, GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.</p> <p><b>Published</b> Without international search report and to be republished upon receipt of that report.</p>

(54) Title: FLUID EXTRACTOR



## (57) Abstract

A mucus extractor comprises a symmetric vessel (1) with an inlet connection (14) for a mucus tube (16) and an outlet connection (15) for a suction tube (17). The diaphragm (12) peripheral is captive at the plane of symmetry. The diaphragm (12) is separating a space (22) to be collapsed by suction from a receiving space (23) into which mucus is drawn by the suction. The effect of the diaphragm (12) is to prevent mucus from entering the suction tube (17) which could be both unpleasant and dangerous.

***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FR	France	ML	Mali
AU	Australia	GA	Gabon	MR	Mauntania
BB	Barbados	GB	United Kingdom	MW	Malawi
BE	Belgium	HU	Hungary	NL	Netherlands
BG	Bulgana	IT	Italy	NO	Norway
BJ	Benin	JP	Japan	RO	Romania
BR	Brazil	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	LI	Liechtenstein	SN	Senegal
CH	Switzerland	LK	Sri Lanka	SU	Soviet Union
CM	Cameroon	LU	Luxembourg	TD	Chad
DE	Germany, Federal Republic of	MC	Monaco	TG	Togo
DK	Denmark	MG	Madagascar	US	United States of America
FI	Finland				

-1-

Fluid ExtractorField of the Invention

The present invention relates to a fluid extractor,  
5 particularly though not exclusively a mucus extractor.

Background of the Invention

A conventional mucus extractor comprises a small jar, a  
lid to the jar having two connections and a pair of tubes  
one connected to one connection and having at its free end a  
10 mouthpiece, the other connected to the other connection and  
having at its free end a nozzle for insertion into a new  
born baby's nostrils and/or mouth. In use, the nozzled tube  
is inserted into the baby's nose for instance and a midwife  
sucks on the mouthpiece to draw mucus from the baby's air  
15 passages to assist its initial breathing. Because a midwife  
can be extremely busy at this stage in the baby's birth, she  
may omit to notice the complete filling of the jar with  
mucus. Then she may suck up mucus into her own mouth. Not  
only can this be extremely unpleasant; but also it is  
20 potentially dangerous as regards infectious diseases.

British patent specification No: 1,273,742 describes a  
mucus extractor suffering from this defect. It has an inlet  
for mucus to a container which is oppositely directed to a  
suction air outlet from the container. However if the  
25 container fills to the level of the air outlet, mucus will  
be sucked up.

British patent application specification No: 2,017,497A  
describes a mucus extractor having an inflatable inner bag  
separated from an outer chamber from which suction air is  
30 withdrawn.

The Invention

The object of the invention is to provide an improved  
mucus extractor.

According to the invention there is provided an  
35 extractor comprising:-

-2-

a vessel for receiving extracted fluid, the vessel being closed in use except for a fluid inlet connection for allowing fluid into the vessel and an air outlet connection for allowing withdrawal of air from the vessel;

5 a flexible diaphragm arranged in the vessel to divide a separated space within the vessel from a fluid receiving space, flexibility of the diaphragm allowing increase in volume of the receiving space on concomitant decrease in volume of the separated space with withdrawal of  
10 air therefrom;

a fluid inlet tube connected to the inlet connection for conveying fluid into the receiving space; and an air outlet tube connected to the outlet connection for withdrawal of air from the separated space.

15 It is envisaged that the extractor may have uses other than as a mucus extractor, for instance as a lock preventing ingestion of liquid from a pipette. However, since the extractor has been invented for use as a mucus extractor, it will be described further in this context.

20 For use as a mucus extractor, the air outlet tube is provided with a mouthpiece, and the fluid tube is preferably provided with a nozzle.

In use the nozzle of the mucus tube is inserted into a baby's mouth or nose and mucus is withdrawn by suction on  
25 the mouthpiece of air tube. Suction causes deflection of the diaphragm with reduction of the volume of the separated space and increase in volume of the mucus receiving space into which mucus is drawn, since there is no appreciable pressure differential across the diaphragm.

30 Should a midwife go on sucking after the diaphragm has moved fully to cause the separated space to be minimized and the mucus receiving space to reach a maximum volume, the mucus cannot be sucked up the air tube because the diaphragm provides permanent separation.

35 An additional unexpected advantage is that should the

-3-

mucus receiving space be full with air and/or mucus and yet further mucus still need to be extracted from the baby, that in the receiver can simply be expelled by tipping the extractor and blowing into the air outlet tube and expelling the mucus via the inlet tube into a suitable receptacle. Then a further extraction operation can be effected.

Preferably, the flexible diaphragm is adapted to at least partially invert between an initial rest position in which the separated space is at a maximum volume and an ultimate position in which the separated space is drawn down to a minimum volume, the diaphragm having at least one peripheral region at which it undergoes substantial angular deviation between its initial position and its ultimate position. The extractor will be manufactured with the diaphragm in its initial rest position. Should it have become displaced prior to use, blowing into the air outlet tube will restore it to its initial position. Then the air pressure can be released prior to use to leave the diaphragm in its initial position.

Conveniently, the flexible diaphragm has two peripheral regions at which it undergoes the said substantial angular deviation and a central area bounded by one of the said regions, the central area being substantially flat in both the maximum and minimum volume conditions of the separated space. The other of the said regions may be adjacent a fixed edge of the flexible diaphragm. Alternatively the diaphragm may have a generally tubular portion extending between a fixed edge and one or both of the said peripheral regions at which it undergoes the said substantial angular deviation, the peripheral regions being arranged around the tubular portion. In this case, the other of the said peripheral regions (where two are provided) is at a peripheral fold in the generally tubular portion of the diaphragm.

In one embodiment, the vessel is symmetric, the

-4-

diaphragm peripheral being captive at the plane of symmetry. Although the diaphragm may extend at rest in this plane of symmetry, preferably it extends out of the plane to lie close to or in contact with a sidewall of the vessel on its receiving space side, in order to maximise the usable receiving space by causing it to be a minimum prior to use and to allow the diaphragm to cross the plane of symmetry without resilient tendency to return to lie in this plane (which tendency would have to be overcome by suction on the air tube). The vessel is preferably provided with ribbing internally extending from the connections to avoid suction of the membrane across the outlet connection in such a manner as to close it prior to complete evacuation of the space being evacuated.

In another embodiment, the vessel has a removable, sealing lid incorporating the inlet and outlet connections, the fixed edge of the diaphragm is fixed to the removable lid and the diaphragm depends from the lid.

To help understanding of the invention, two specific embodiments thereof will now be described by way of example and with reference to the accompanying drawings in which:-  
The Drawings

Figure 1 is a cross-sectional side view of a mucus extractor according to the invention on the line I-I in Figure 1;

Figure 2 is a cross-sectional underneath plan view of the mucus extractor of Figure 1 on the line II-II in that figure;

Figure 3 is an enlarged scrap view of a detail of Figure 2;

Figures 4, 5 and 6 show diagrammatically use of the mucus extractor of Figure 1;

Figure 7 is a cross-sectional side view of another mucus extractor according to the invention on the line VII-VII in Figure 9;

-5-

Figure 8 is a scrap view of a detail of Figure 7; and  
Figure 9 is a plan view of the mucus extractor of Figure

7.

First Embodiment

5 Referring first to Figures 1, 2 and 3, the mucus  
extractor has a vessel 1 which is an assembly on a plane of  
symmetry 2 of two injection moulded shells 3,4. The shells  
are of clear plastics material such as acrylic or  
polystyrene. Each, identical, shell is of trapezoidal  
10 shape, being initially open at its base plane. A rim 5,6 is  
provided extending outwardly at the base plane. In the  
surface of the rim 5,6, which will mate with the other 6,5  
on assembly, there is provided a continuous groove 7,8  
extending around the entire rims 5,6. Inwardly of the  
15 grooves 7,8 the mating surface of the rims 5,6 is relieved  
9,10 to leave a small gap which is occupied by an edge  
portion 11 of an elastomeric diaphragm 12 of neoprene,  
polyurethane or natural rubber. At its edge the diaphragm  
has a bead 13 captive after assembly in the grooves 7,8. On  
20 assembly of the diaphragm to one shell, typically 3 into  
which the diaphragm 12 extends in its free state, and of the  
other shell 4 to the one, the two shells are welded, as by  
ultrasound, or adhered together at the rims 5,6, thereby  
sealing the diaphragm to both shells.

25 Each shell 3,4 has an integrally moulded connection  
spout 14,15 to each of which is connected a tube 16,17.  
With the diaphragm extending towards the shell 3 in its free  
position, the tube 16 becomes the mucus inlet tube and is  
provided at its free end with a nozzle 18 in the form of a  
30 slight tapering of the tube. The other, air outlet, tube 17  
has at its free end a mouthpiece 19. To avoid suction or  
pressing of the diaphragm against the inner orifice of  
either spout 14,15 without the diaphragm lying close against  
the rest of the respective shell 3,4, ribs 20,21 extend on  
35 the inner surface of the shells to the opposite ends thereof

-6-

thus providing fluid communication from the spouts to the other ends of the shells.

In use, with the diaphragm 12 initially lying close to or against the shell 3, because of the shape of the diaphragm as moulded, the separated space 22 between the diaphragm and the other shell 4 is at a maximum, see Figure 4. This space 22 is separated from the mucus tube 16 by the diaphragm. On insertion of the nozzle 18 into mucus and suction on the air tube 17 via the mouthpiece 19, the volume of the separated space reduces as the diaphragm moves away from the shell 3, see Figure 5. This movement leaves a mucus receiving space 23 between the shell 3 and the diaphragm. Mucus 24 is drawn into this space 23, until the diaphragm lies fully against the shell 4, see Figure 6. This results in substantial angular deviation of adjoining parts of the diaphragm at two peripheral regions 25, 26. Region 25 is adjacent the captive edge 11 of the diaphragm. Region 26 is adjacent a central area 27 of the diaphragm which is flat in the rest position of the diaphragm, Figure 4, and in the fully inverted position, Figure 6, of the diaphragm. The angular deviation of the diaphragm is approximately 140°.

If insufficient mucus has at this stage been extracted from the baby, the already extracted mucus 24 can be expelled into a suitable receptacle by blowing through mouthpiece 19. A further extraction can then be carried out. At no time can mucus be drawn through the air tube 17.

#### Second Embodiment

Turning now to Figures 7, 8 and 9, a second mucus extracor will now be described. It has a vessel 100 comprised of a tub 101 and a screw-top lid 102. The lid has a mucus inlet connection 103 for a mucus inlet tube 104 and an air outlet connection 105 for an air outlet tube 106. Depending from the lid 102 within the tub 101 is a diaphragm-guiding, circular cylinder 107 and a plurality of

-7-

resilient, catch fingers 108. Both lid and the tub are injection moulded of material such as polyethylene. The fingers 108 are arranged circularly around the cylinder 107, outwardly of a circular bead 109 integrally moulded on the inner face of the lid.

A tubular diaphragm 110 is fitted over the guide cylinder 107, with a radially extending rim 111 captive by a ring 112 held by the fingers 108, see in particular Figure 8. The ring 112 has a bead 113 opposite the lid bead 109, so that, when the ring is snapped into position held by the fingers, the diaphragm rim 111 is sealingly fixed to the lid. The diaphragm has a tubular portion 114 extending outside the guide cylinder 107 as far as a peripheral S fold 115. Beyond this, the diaphragm extends as a further tubular portion 116 to a central bottom 117, which is substantially flat and closes the tubular portions of the diaphragm. The tubular portions 114, 116 are of substantially the same length. The diaphragm divides the internal space of the vessel 100 into a separated space 122 and a receiving space 123.

In use, a nozzle (not shown) on the mucus inlet tube 104 is inserted into a neonate's nostril and suction is applied to a mouthpiece (not shown) on the air outlet tube 106. The diaphragm is displaced from its rest position in Figure 7. On progressive displacement, the S fold 115 rolls upwards inside the guide cylinder 107, with the diaphragm locally inverting and deflecting at the S fold through 180°. The lower tubular portion 116 and the central bottom 117 of the diaphragm move up towards the lid. The fully displaced, inverted position of the diaphragm is shown in dashed outline 118. In this position the corner 119 between the tubular portion 116 and the central bottom 117 turns inside-out with an angular deflection of 180°. To avoid any possible bowing of the central portion 117 closing the air outlet 105, ribs 120 radiating therefrom on the inner face

-8-

of the lid 102 are provided. It will be noted that although the diaphragm deflects from bottom to top of the vessel it is of smaller diameter than the tub, therefore the maximum volume displaced by the diaphragm is less than the total  
5 volume available for receiving mucus. Accordingly, at least with one deflection of the diaphragm, air is left above the mucus drawn into the extractor and the mucus cannot syphon back out when the extractor is stood with its flat bottom 121 on a level surface. To render the diaphragm light and  
10 thin, it is of blow-, vacuum- or dip-moulded elastomer such as silicone rubber.

Should the mucus be required for analysis, the lid 102 can be replaced by a conventional screw top lid.

The invention is not intended to be restricted to the  
15 details of the above described embodiments. For instance, the two shells 3, 4 may have resilient formations such that they clip together on assembly, captivating the diaphragm and sealing it to each of them. Alternatively, where the diaphragm and the shells are all of the same material, for  
20 instance polyethylene the diaphragm may be welded or adhered to both shells. The lid 102 may be resiliently or indeed permanently secured onto the tub 101. The diaphragm 110 may be bonded onto the lid 102. The rolling diaphragm may be replaced by other configurations such as a  
25 hemispherical diaphragm or a bellows diaphragm.

30

35

Claims

1. A fluid extractor comprising:-

5 a vessel (1;100) for receiving extracted fluid, the vessel being closed in use except for a fluid inlet connection (14;103) for allowing fluid into the vessel and an air outlet connection (15;105) for allowing withdrawal of air from the vessel;

10 a flexible diaphragm (12;110) arranged in the vessel to divide a separated space (22;122) within the vessel from a fluid receiving space (23;123), flexibility of the diaphragm allowing increase in volume of the receiving space on concomitant decrease in volume of the separated space with withdrawal of air therefrom;

15 a fluid inlet tube (16;104) connected to the inlet connection for conveying fluid into the receiving space; and an air outlet tube (17;106) connected to the outlet connection for withdrawal of air from the separated space.

2. A fluid extractor as claimed in claim 1, wherein the  
20 flexible diaphragm (12;110) is adapted to at least partially invert between an initial rest position in which the separated space is at a maximum volume and an ultimate position in which the separated space is drawn down to a minimum volume, the diaphragm having at least one peripheral  
25 region (25,26;115,119) at which it undergoes substantial angular deviation between its initial position and its ultimate position.

3. A fluid extractor as claimed in claim 2, wherein the flexible diaphragm (12;110) has two peripheral regions  
30 (25,26;115,119) at which it undergoes the said substantial angular deviation and a central area (27;117) bounded by one of the said regions, the central area being substantially flat in both the maximum and minimum volume conditions of the separated space (22;122).

35 4. A fluid extractor as claimed in claim 3, wherein the

-10-

other (25) of the said regions is adjacent a fixed edge (11) of the flexible diaphragm.

5 5. A fluid extractor as claimed in claim 4, wherein the vessel comprises two substantially identical halves (3,4) joined at a medial plane (2) at which the edge (11) of the diaphragm is fixed.

10 6. A fluid extractor as claimed in claim 3, wherein the diaphragm has a generally tubular portion (114,116) extending between a fixed edge (111) and one or both of the said peripheral regions (115,119) at which it undergoes the said substantial angular deviation, the peripheral regions being arranged around the tubular portion.

15 7. A fluid extractor as claimed in claim 6, wherein the other (115) of the said peripheral regions is at a peripheral fold (115) in the generally tubular portion (114,116) of the diaphragm.

20 8. A fluid extractor as claimed in any one of claims 1 to 4, 6 and 7, wherein the vessel has a removable, sealing lid (102) incorporating the outlet connection (103), a fixed edge (111) of the diaphragm being fixed to the removable lid and the diaphragm depending from the lid.

9. A fluid extractor as claimed in claim 8, wherein the removable lid (102) incorporates the inlet connection (105).

25 10. A fluid extractor as claimed in either of claims 8 and 9 as appendant to claim 7, wherein the lid has a depending cylinder (107) extending inside the diaphragm as far as the fold (115) for controlled, rolling movement of the diaphragm.

30 11. A fluid extractor as claimed in any preceding claim, wherein the extractor has a flat bottom (121) and the inlet connection (103) is remote from the flat bottom.

12. A fluid extractor as claimed in any preceding claim, wherein the maximum volume of the separate space (122) is less than the maximum volume of the receiving space (123).

35 13. A fluid extractor as claimed in any preceding claim,

-11-

including ribs (20,21;120) on the inside of the vessel radiating from the outlet connection (15;105).

14. A fluid extractor as claimed in any preceding claim, wherein the flexible diaphragm (12;110) is of vacuum-, blow-  
5 or dip-formed elastomeric material.

15. A fluid extractor as claimed in any preceding claim, wherein the inlet tube (16;104) has a nozzle (18) adapting the extractor for extracting mucus from a nostril of a neonate and the outlet tube (17;106) has a mouthpiece (19)  
10 for human suction on the outlet tube.

15

20

25

30

35

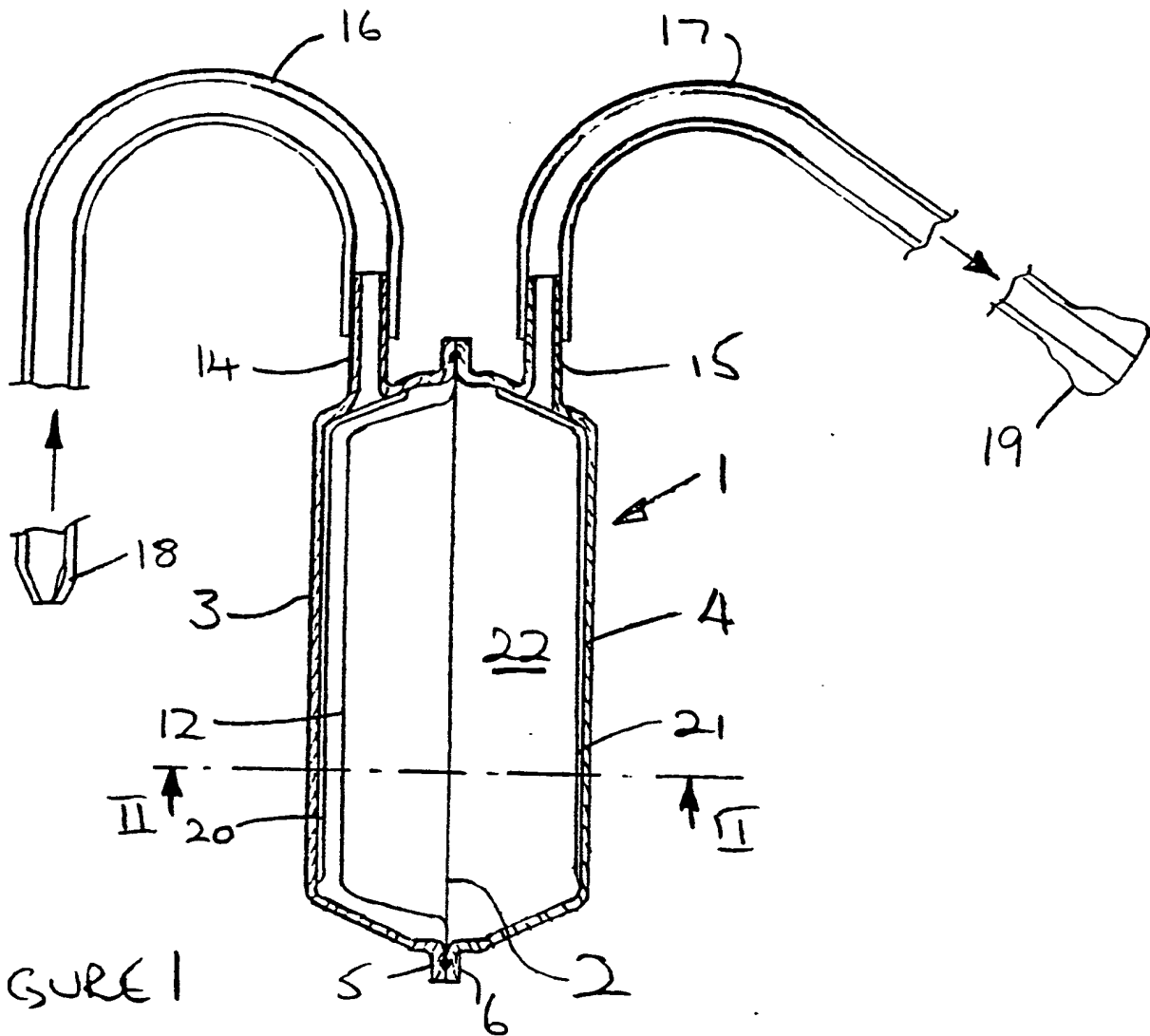


FIGURE 1

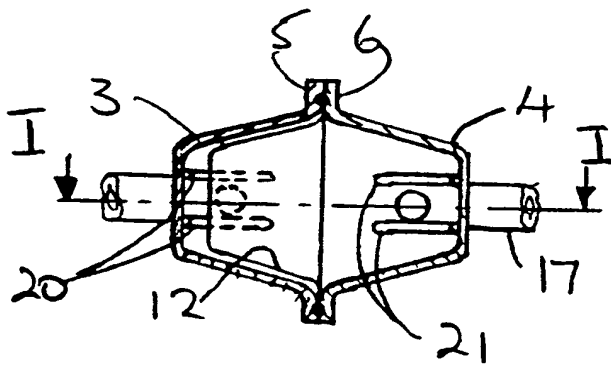


FIGURE 2

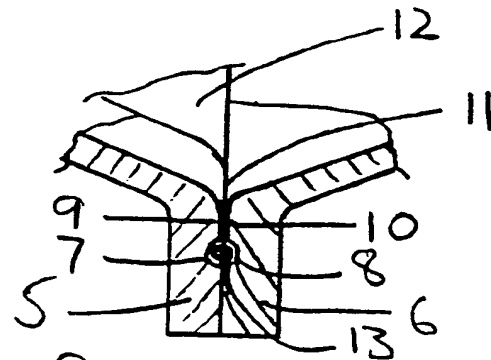
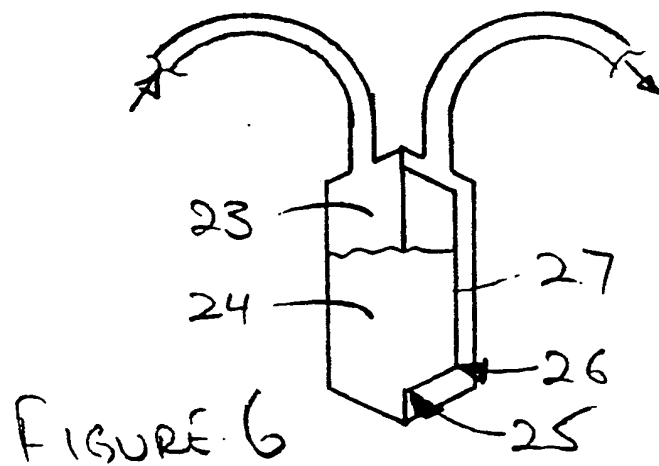
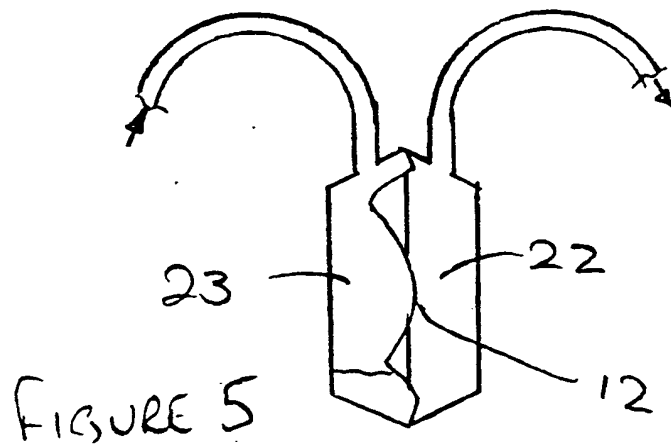
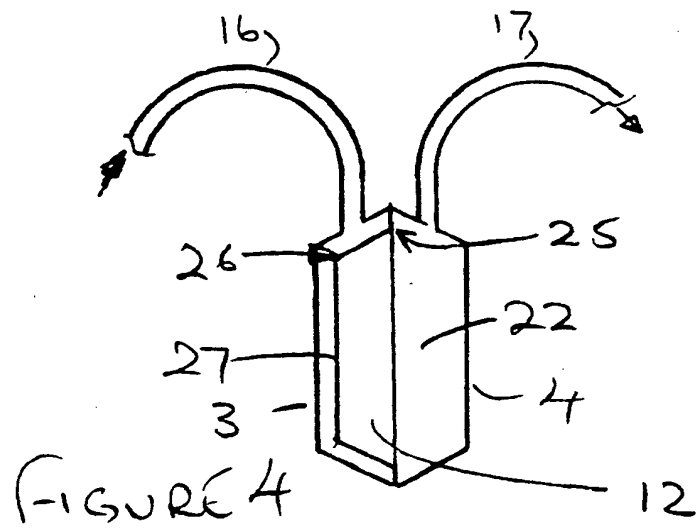
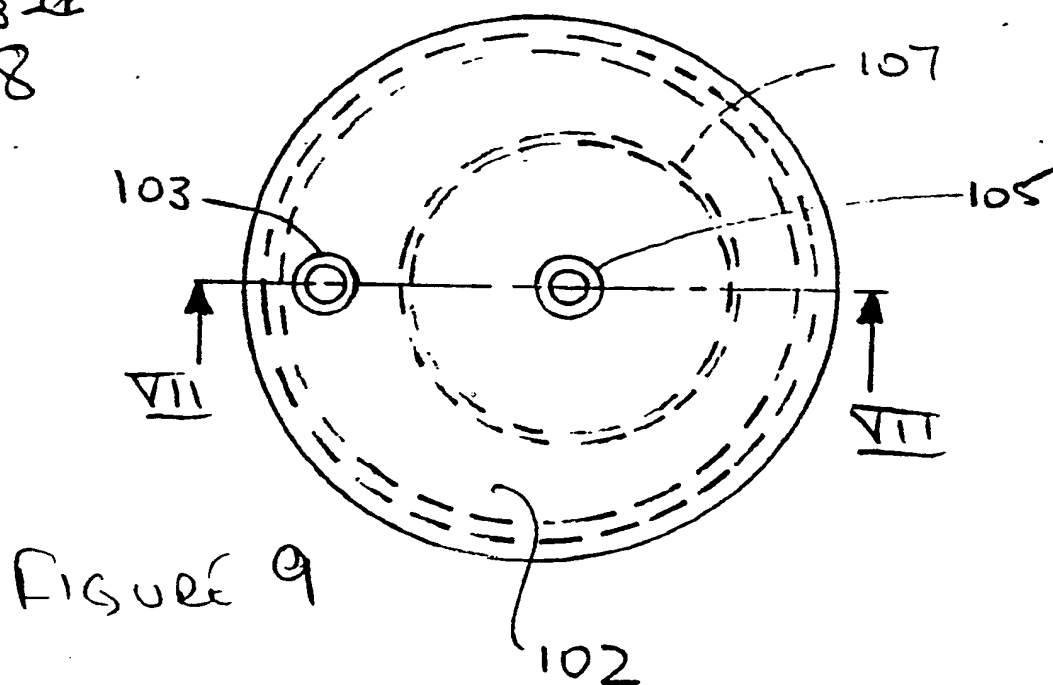
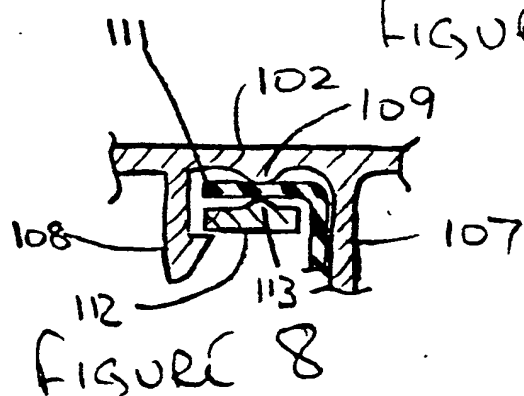
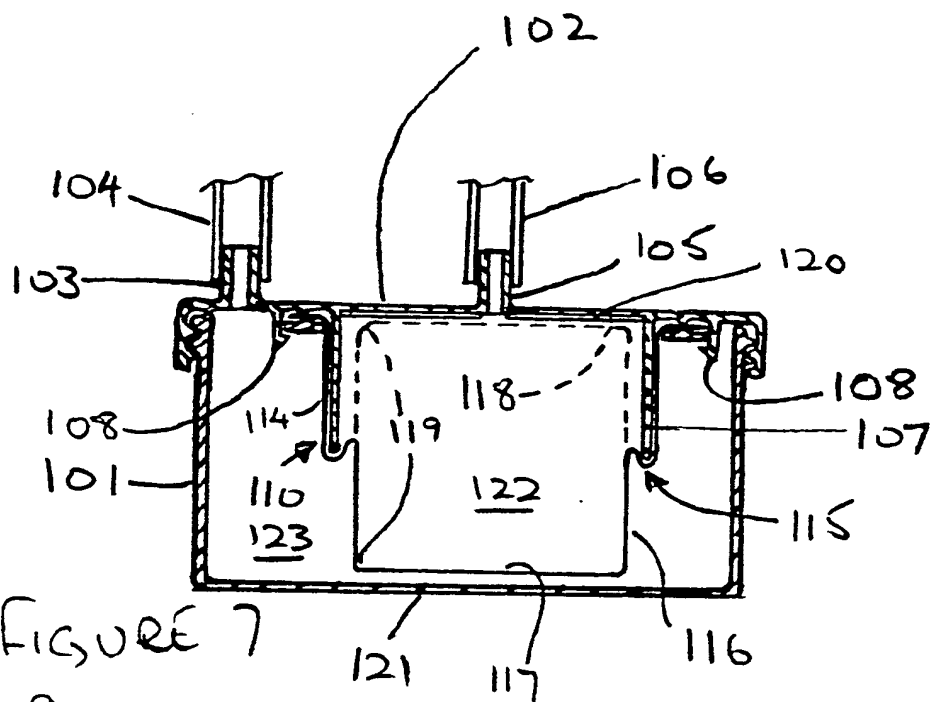


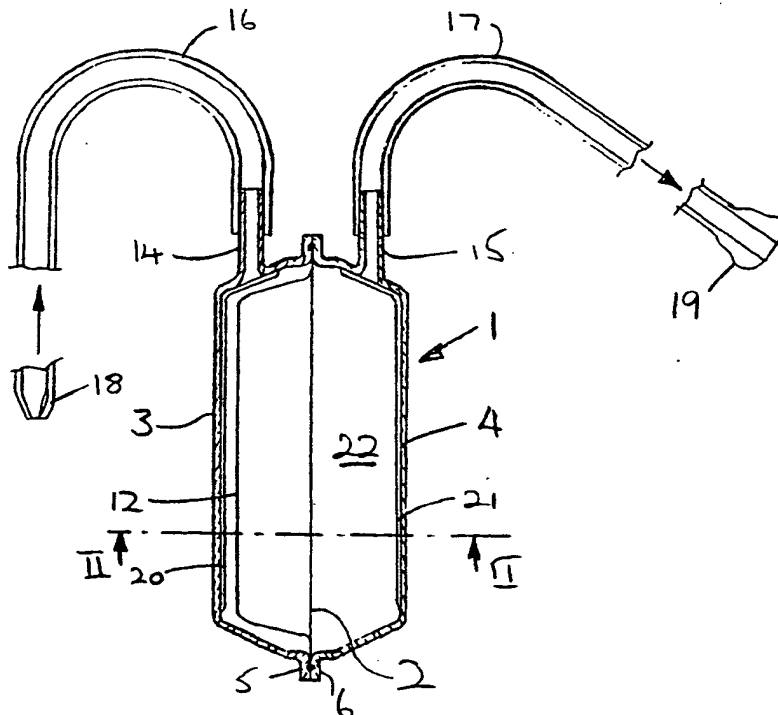
FIGURE 3





## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification<sup>4</sup>:</b>  <b>A61M 1/00</b>	<b>A3</b>	<b>(11) International Publication Number:</b> <b>WO 89/ 05665</b>  <b>(43) International Publication Date:</b> 29 June 1989 (29.06.89)
<b>(21) International Application Number:</b> PCT/GB88/01122 <b>(22) International Filing Date:</b> 23 December 1988 (23.12.88) <b>(31) Priority Application Number:</b> 8730064 <b>(32) Priority Date:</b> 23 December 1987 (23.12.87) <b>(33) Priority Country:</b> GB <b>(71)(72) Applicants and Inventors:</b> VEALE, Francis, Clement [GB/GB]; VEALE, Moray, Sian [GB/GB]; 11 Victory Avenue, Horndean, Hampshire PO8 9PH (GB). <b>(74) Agent:</b> BROOKS, Nigel; Hill Hampton, East Meon, Petersfield, Hampshire GU32 1QN (GB).		<b>(81) Designated States:</b> AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB, GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>  <b>(88) Date of publication of the international search report:</b> 10 August 1989 (10.08.89)

**(54) Title:** FLUID EXTRACTOR**(57) Abstract**

A mucus extractor comprises a symmetric vessel (1) with an inlet connection (14) for a mucus tube (16) and an outlet connection (15) for a suction tube (17). The diaphragm (12) peripheral is captive at the plane of symmetry. The diaphragm (12) is separating a space (22) to be collapsed by suction from a receiving space (23) into which mucus is drawn by the suction. The effect of the diaphragm (12) is to prevent mucus from entering the suction tube (17) which could be both unpleasant and dangerous.

***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FR	France	ML	Mali
AU	Australia	GA	Gabon	MR	Mauritania
BB	Barbados	GB	United Kingdom	MW	Malawi
BE	Belgium	HU	Hungary	NL	Netherlands
BG	Bulgaria	IT	Italy	NO	Norway
BJ	Benin	JP	Japan	RO	Romania
BR	Brazil	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	LI	Liechtenstein	SN	Senegal
CH	Switzerland	LK	Sri Lanka	SU	Soviet Union
CM	Cameroon	LU	Luxembourg	TD	Chad
DE	Germany, Federal Republic of	MC	Monaco	TG	Togo
DK	Denmark	MG	Madagascar	US	United States of America
FI	Finland				

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 88/01122

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>4</sup> According to International Patent Classification (IPC) or to both National Classification and IPC IPC <sup>4</sup> : A 61 M 1/00																				
<b>II. FIELDS SEARCHED</b> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched <sup>7</sup></div> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%; border-bottom: 1px solid black;">Classification System</td> <td style="border-bottom: 1px solid black;">Classification Symbols</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">IPC<sup>4</sup></td> <td style="border: 1px solid black; padding: 5px;">A 61 M</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup></div>			Classification System	Classification Symbols	IPC <sup>4</sup>	A 61 M														
Classification System	Classification Symbols																			
IPC <sup>4</sup>	A 61 M																			
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%; text-align: left;">Category <sup>10</sup></th> <th style="width: 70%; text-align: left;">Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup></th> <th style="width: 20%; text-align: left;">Relevant to Claim No. <sup>13</sup></th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>FR, A, 2346238 (RHONE-POULENC INDUSTRIES) 28 October 1977 see page 2, line 14 - page 3, line 9; claims 1-3,5; figure 2</td> <td style="vertical-align: top;">1,2,14</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td style="text-align: center;">--</td> <td style="vertical-align: top;">3-5,15</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>US, A, 4058123 (MAY) 15 November 1977 see column 3, line 66 - column 4, line 1; column 4, line 25 - column 6, line 12; figures 1,3-5</td> <td style="vertical-align: top;">3-5</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>GB, A, 1273742 (AHTERLEY) 10 May 1972 see page 2, lines 6-25; figure 1 cited in the application</td> <td style="vertical-align: top;">15</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>FR, A, 1214265 (PARKINSON COWAN LTD) 7 April 1960 see page 2, column 1, line 28 - column 2, line 36; figure 2</td> <td style="vertical-align: top;">3</td> </tr> </tbody> </table>			Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>	X	FR, A, 2346238 (RHONE-POULENC INDUSTRIES) 28 October 1977 see page 2, line 14 - page 3, line 9; claims 1-3,5; figure 2	1,2,14	Y	--	3-5,15	Y	US, A, 4058123 (MAY) 15 November 1977 see column 3, line 66 - column 4, line 1; column 4, line 25 - column 6, line 12; figures 1,3-5	3-5	Y	GB, A, 1273742 (AHTERLEY) 10 May 1972 see page 2, lines 6-25; figure 1 cited in the application	15	A	FR, A, 1214265 (PARKINSON COWAN LTD) 7 April 1960 see page 2, column 1, line 28 - column 2, line 36; figure 2	3
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>																		
X	FR, A, 2346238 (RHONE-POULENC INDUSTRIES) 28 October 1977 see page 2, line 14 - page 3, line 9; claims 1-3,5; figure 2	1,2,14																		
Y	--	3-5,15																		
Y	US, A, 4058123 (MAY) 15 November 1977 see column 3, line 66 - column 4, line 1; column 4, line 25 - column 6, line 12; figures 1,3-5	3-5																		
Y	GB, A, 1273742 (AHTERLEY) 10 May 1972 see page 2, lines 6-25; figure 1 cited in the application	15																		
A	FR, A, 1214265 (PARKINSON COWAN LTD) 7 April 1960 see page 2, column 1, line 28 - column 2, line 36; figure 2	3																		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><sup>10</sup> Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"A" document member of the same patent family</p> </div> </div>																				
<b>IV. CERTIFICATION</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">           Date of the Actual Completion of the International Search             31st March 1989         </td> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">           Date of Mailing of this International Search Report             6 JUL 1989         </td> </tr> <tr> <td style="border-bottom: 1px solid black; padding: 5px;">           International Searching Authority             EUROPEAN PATENT OFFICE         </td> <td style="border-bottom: 1px solid black; padding: 5px;">           Signature of Authorized Officer             P.C.G. VAN DER PUTTEN         </td> </tr> </table>			Date of the Actual Completion of the International Search  31st March 1989	Date of Mailing of this International Search Report  6 JUL 1989	International Searching Authority  EUROPEAN PATENT OFFICE	Signature of Authorized Officer P.C.G. VAN DER PUTTEN														
Date of the Actual Completion of the International Search  31st March 1989	Date of Mailing of this International Search Report  6 JUL 1989																			
International Searching Authority  EUROPEAN PATENT OFFICE	Signature of Authorized Officer P.C.G. VAN DER PUTTEN																			

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE <sup>1</sup>

This International search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ..... because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claim numbers ..... because they relate to parts of the International application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claim numbers ..... because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING <sup>2</sup>

This International Searching Authority found multiple inventions in this International application as follows:

1. Claims 1-3 and 4,5,13-15: Symmetric vessel, figures 1-6
2. Claims 1-3 and 6-12,13-15: Non symmetric vessel with tubular diaphragm, figures 7-9

1. ☐ As all required additional search fees were timely paid by the applicant, this International search report covers all searchable claims of the International application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this International search report covers only those claims of the International application for which fees were paid, specifically claims:
3. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:  
1-3 and 4,5,13-15
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

## Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.**

GB 8801122  
SA 26085

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 15/06/89  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR-A- 2346238	28-10-77	JP-A- 52120593	11-10-77
US-A- 4058123	15-11-77	US-A- 4112947	12-09-78
GB-A- 1273742	10-05-72	None	
FR-A- 1214265		None	

**THIS PAGE BLANK (USPTO)**

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**

**THIS PAGE BLANK (USPTO)**